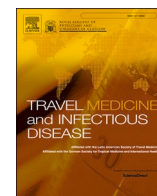




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## Is sports performance affected by the travel restrictions and infectious prevention policy during pandemic? A case of 2020 Tokyo Olympic Games

Dear Editor,

Since the COVID-19 pandemic, many countries have taken various measures to confine the epidemic such as border closure, reducing flights and different policies on quarantine [1], but the condition is still not under complete control. The 32nd Summer Olympic Games, originally scheduled to be held in 2020, were postponed for a year due to the COVID-19 pandemic. Finally, the games began on July 23, 2021, lasted 15 days and drew to a close on August 8. Participants and equipment from more than 200 countries were transported to Tokyo which caused a slight increase in airline business and strict policies were applied. However, with the spread of the Delta variant and the booming surge of confirmed cases in Japan, the Olympics faced unprecedented challenges. Therefore, it is debatable to what extent the performance of the 2020 Tokyo Olympic Games had been affected by the global pandemic, strict travel restrictions, and continued infections.

Field and Track athletics is the oldest discipline and contains 48 events which award the most gold medals in the Olympics. Therefore, the results of athletics can basically reflect the overall situation of the Olympics. Here, the results of Athletics of the 2012 London Olympic Games, the 2016 Rio Olympic Games and the 2020 Tokyo Olympic Games are selected as the research objects for comparative analysis.

This study will select the top three results of 47 athletics events (the 4 × 400 m relay mixed in athletics was not selected as this was a new event at the 2020 Olympic Games) at the 2012, 2016 and 2020 Olympic Games and compare the fixed base dynamic ratio by tendency analysis method which can reflect the variance of athletics results at the three most recent Olympic Games (Fig. 1) [2].

We found that only the result of women's sprint, hurdles and relay race between Tokyo Olympics and Rio Olympics ( $P = 0.036 < 0.05$ ), was significantly different in Table 1. The main reason is that the performance of women's 400 m hurdles at the Tokyo Olympic Games was 1.78 seconds higher than that at the Rio Olympic Games and it broke the Olympic record. The results of other events do not show significant differences.

Through data analysis, it can be seen that compared with the previous two Olympic Games, the performance results of 25 events at the Tokyo Olympic Games went up and the results of 22 events went down among 47 athletics events. Although the performance results rose and fell, the largest variations of the two adjacent games are no more than 5%, which indicates the results did not change much. Most of the performance results of the Tokyo Olympic Games and the Rio Olympic Games and comparison of the Tokyo Olympic Games and the London Olympic Games show no significant difference in Table 1. In terms of breaking records, these 3 Olympic Games were almost the same. At the 2012 Olympic Games, 4 world records and 5 Olympic records were broken. 3 world records and 5 Olympic records were broken at the 2016

Olympic Games. There were 3 world records, 6 Olympic records and 1 under-20 world record at the Tokyo Olympic Games. As a result, the performance of the 32nd Olympic Games in Tokyo has not been affected significantly by COVID-19 associated travel restrictions and infectious prevention policies.

Moreover, even though adult males are more likely to be vulnerable to infection from the COVID-19, as was suggested in early reports of the pandemic and suggested use anti-androgen therapy inspired from prostate cancer treatment after later analysis, the performance among male athletes was also not affected and the effect shows no significant difference between male and female sports events' performance [3]. This might be due to the strong immunity of athletes to resist the COVID-19 infection or symptoms which results in mild but possibly prolonged return to sports as cardiac magnetic resonance (CMR) imaging test of myocarditis may show (in a small cohort study of 15%) [4,5].

The following reasons may contribute to the stable results of the 2020 Tokyo Olympic Games, in addition to the most frequent PCR testing. (1) Most Olympic athletes are first class sports people who have regular lifestyles and strong self-discipline. They can restrain their own behaviors to focus on training and consciously reduce social contact or gathering. Meanwhile, the coaching team and medical supervision have developed a comprehensive medical, psychological and pandemic prevention plan. These methods can guarantee most athletes were not infected. (2) When the 2020 Olympic Games were postponed for one year and many games were cancelled due to travel restrictions, the coaching team might have adjusted the training plan accordingly. With the support of scientific training methods and high-tech conditions, the athletes were not affected and maintained a highly competitive level. (3) To reduce the possibility of being infected, a series of strict measures were adopted and corresponding penalties were applied. For example, wearing face mask at all times, washing hands frequently, reducing physical interactions, maintaining social distance and cancelling public attendance were applied and monitored. The new position of CLO (COVID-19 Liaison officer) was created to help each team with the pandemic related issues. Epidemic prevention bubbles were established and all the participants were restricted in Olympic bubbles to restrict the interaction with non-participants to a minimum level. The counter-measures that lasted from 14 days before the arrival, through the whole journey in Japan and the departure were all mentioned clearly in the playbook. If the participants were to break the rules, they would face varying levels of punishment such as warnings, fines and revoking licenses. (4) After the Tokyo Olympic Games, it has been found that many epidemic prevention strategies from some countries are worth advocating and studying. For example, to make participants understand the requirements of the Tokyo 2020 Organizing Committee completely, the playbook was translated into their native languages. The team CLOs

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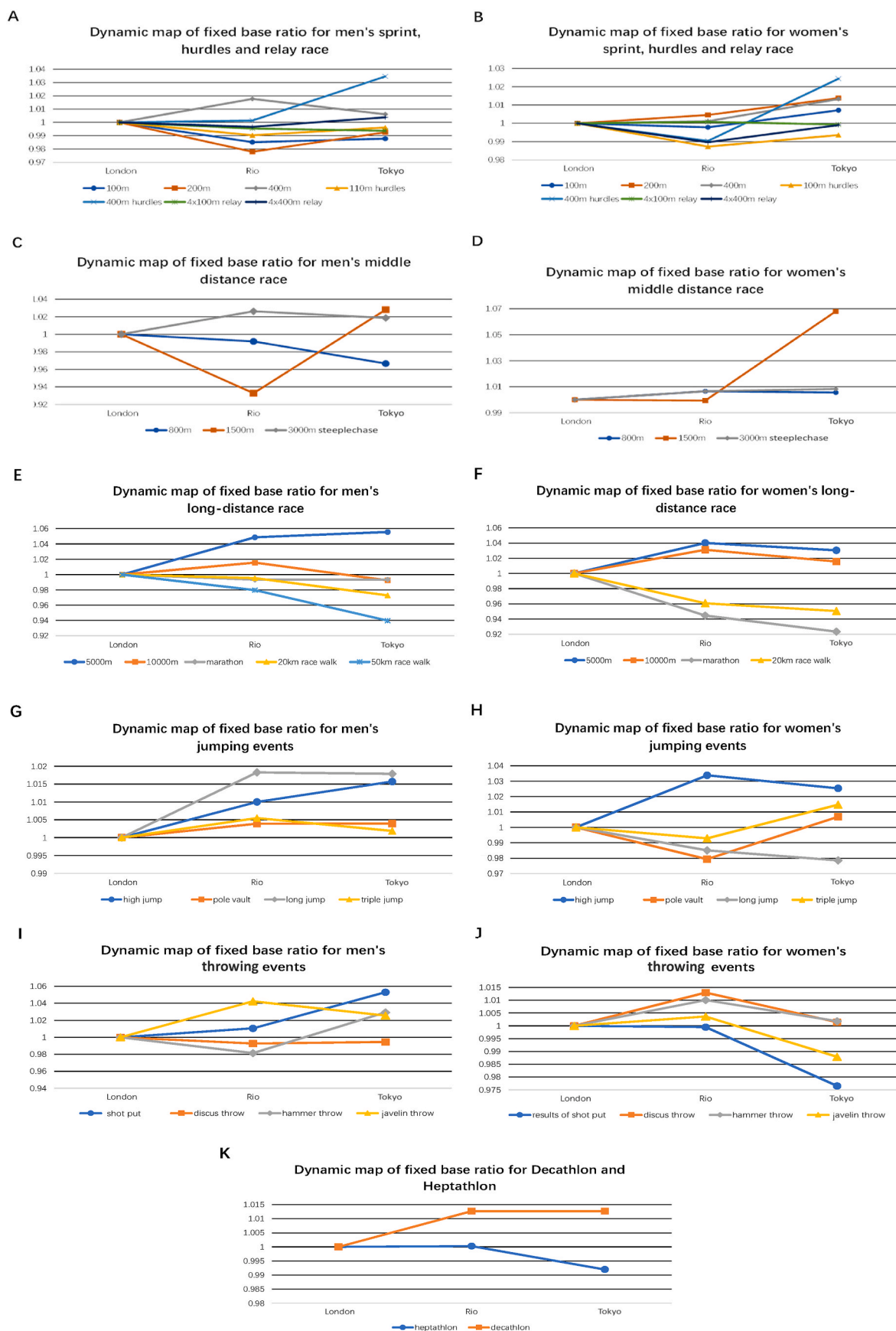


Fig. 1. Performance results of different types of sports event in Tokyo 2020 Olympics games compared to the previous two events.

**Table 1**

Comparisons of relative performance results of athletic events between Tokyo vs Rio and Tokyo vs London.

| Classifications                        | p value      |                 |
|--|--------------|-----------------|
|  | Tokyo vs Rio | Tokyo vs London |
| Men's sprint, hurdles and relay race   | 0.367        | 0.727           |
| Men's middle distance race             | 0.565        | 0.825           |
| Men's long-distance race               | 0.504        | 0.640           |
| Women's sprint, hurdles and relay race | 0.036*       | 0.100           |
| Women's middle distance race           | 0.323        | 0.252           |
| Women's long-distance race             | 0.703        | 0.465           |
| Men's jumping events                   | 0.937        | 0.051           |
| Men's throwing events                  | 0.332        | 0.077           |
| Women's jumping events                 | 0.608        | 0.549           |
| Women's throwing events                | 0.074        | 0.231           |
| Decathlon and heptathlon               | 0.763        | 0.843           |

\*:  $p < 0.05$ .

were set up to cooperate with the CLO of the Olympic Organizing Committee which could help athletes to reduce contact with others [6]. The 14 days' self-isolation before the journey was strictly enforced. The personal protective knowledge, the collecting process of samples and the customs clearance process were recorded as short videos for delegation members to become familiar with the epidemic prevention requirements and to reduce panic or confusion when entering the country. Individual fitness rooms or treatment rooms were established to reduce the possibility of cross infection. Moreover, vaccination against COVID-19 proved to be effective.

In conclusion, all the above measures ensured the successful convening of the Olympic Games and the sports performance was not affected by the travel restrictions and the infection risk caused by the COVID-19 pandemic.

#### Ethics approval and consent to participate

N/A.

#### Consent for publication

N/A.

#### Availability of data and materials

N/A.

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#### Authors' contributions

Yingqiu Xie proposed the concept, and wrote part of the paper.

Dongsheng Liu, Shuai Liu performed data collection, analysis and wrote the draft. Ying Wang analyzed data, wrote paper, and revised paper.

#### Declaration of competing interest

There is nothing to declare in this project.

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Dongsheng Liu<sup>1</sup>

Department of General Education (Sports and Arts), Shandong First Medical University, Jinan, China  
E-mail address: [ldse@163.com](mailto:ldse@163.com).

Shuai Liu<sup>2</sup>

Shandong First Medical University, Jinan, China

Yingqiu Xie

School of Sciences and Humanities, Nazarbayev University, Nur-Sultan, Kazakhstan

Ying Wang\*

Department of Scientific Research, Shandong First Medical University, Jinan, China

\* Corresponding author.

E-mail address: [wangying@sdfmu.edu.cn](mailto:wangying@sdfmu.edu.cn) (Y. Wang).

<sup>1</sup> Co-first authors.

<sup>2</sup> Co-first authors.